Amendments to the Drawings:

The three attached sheets of drawings (attached as an Appendix to the Amendment) include changes to Figures 9, 13 and 14, respectively. These figures have been adjusted to place emphasis on the use of reinforced composite material that is manufactured by filling in empty spaces of a three-dimensional wire-woven cellular light structure with a resin, a ceramic, or a metal as per claims 7, 8, 15 and 16. These replacement drawings find support through the original specification as filed and do not constitute new matter.

Attachments: Three (3) Replacement Drawing Sheets for FIGURES 9, 13, 14, respectively
Three (3) Annotated Sheets Showing Changes

REMARKS/ARGUMENTS

Claims 1-16 are pending in this application. Claims 1-16 are rejected by the Examiner. Claims 1 and 9 have been amended to render in a more precise and clear manner that which Applicants deem to be the inventive subject matter of the application. No new matter has been added by this amendment.

The Examiner has objected to two particular passages in the specification. Applicants acknowledge and appreciate the Examiner's attention to detail in catching the typographical errors addressed. Applicants have accordingly amended the paragraph that includes the erroneous term "oriential-wire" at page 12, line 12, so that the term correctly reads as "orientational-wire." Applicants have also clarified other minor typographical issues in that same paragraph.

Applicants have further made appropriate amendments to the paragraph which had included the phrase, "so as to an equilateral triangle," at page 12, line 18 so as to render the phrase meaningful, *i.e.*, "so as to form an equilateral triangle." No new matter has been introduced by the amendments to the specification.

Applicants have herewith also submitted replacement formal drawing sheets for Figures 9, 13 and 14 of the application to clarify that which Applicants deem to be inventive subject matter, including with regard to claims 7, 8, 15 and 16. No new matter has been introduced with the replacement drawing sheets.

Claim Rejections under 35 U.S.C. § 102(b)

Claims 1-6 are rejected under 35 U.S.C. § 102(b), as being anticipated by Snelson (US/2002/0081936 A1) for the reasons set forth in pp. 3-5 of the Office Action.

In response, Applicants note that claim 1 has been amended to clarify and render more precisely that which Applicants deem to be the inventive subject matter of the present disclosure. Applicants respectfully point out that the cited Snelson art relates to a three-dimensional cellular structure using a plurality of rod members, wherein its unit cell has a similar, yet not identical,

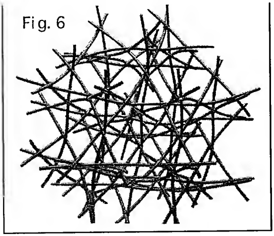
structure to that of the present invention. It is critical to note, however, that the present invention as presently recited in the amended set of claims and the cited Snelson art, in fact, *do possess salient differences in structure* and are remarkably distinct with regard to the construction, resulting effect on performance (strength) and overarching purpose of the structure.

In Claim 1 of Snelson, a toy construction kit comprising a plurality of elongated rod members of *different lengths* and *a plurality of joining members*, each configured to be connectable to form a three-dimensional polyhedron member, are requisite elements. In Claim 1 of the present invention, however, a truss-type three-dimensional wire-woven cellular structure, in which *regular* tetrahedron members woven by continuous wires (without need for joining members) are *repeatedly formed in a regular pattern*, is an essential structure.

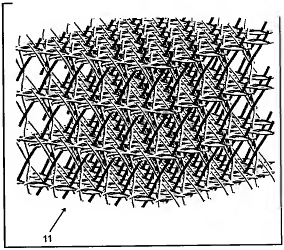
Snelson suggests only that a toy construction kit can form a three-dimensional space structure by using the rod members of different lengths and the joining members. There is no disclosure in Snelson, explicit or inherent, that the polyhedron structure *must* be a regular polyhedron structure with equilateral sides. The present invention, however, requires that the unit cell having the three-dimensional cellular structure should be a "regular tetrahedron structure with equilateral sides." Moreover, since each element of the truss making up one regular tetrahedron has the same length, it is apparent that all elements of the truss in the overall structure configured by the repetition of the regular tetrahedron structure have the same length.

The following drawings are demonstrative of the structural differences between the cited Snelson art reference and the three-dimensional cellular structure of the present invention, respectively.

(Embodiment of the structure using the kit of the cited Snelson art reference)



(Three-dimensional wire-woven cellular light structure of present invention)



As can be seen from the above drawings, the lengths of the sides of each polyhedron in the sample structure of the cited Snelson art need not be equal and are not equal, in striking contrast to the present disclosure. This is because, at least in part, the three-dimensional structure of the Snelson art, unlike that of Applicants, is not made for the purpose of obtaining superior mechanical strength.

With the present invention, the lengths of the sides of the unit cell in the cellular structure of the present invention must be equal and the lengths of all truss elements are equal. As a result, in that each unit cell possesses similar structure to the Octet or Kagome truss, the six-orientational mechanical properties of the present invention are similarly superior in mechanical strength.

As mentioned above, if the lengths of the truss elements are not necessarily equal (as per Snelson), the cellular structure will not exhibit superior strength. As an illustrative example, the industry makes use of "metal foam"-which is a kind of cellular material configured with non-uniform cells-that possesses low structural strength because of its stochastic structure (*see, e.g.*, H.N.G. Wadley, Advanced Engineering Materials, Vol. 4, pp.726-733, 2002).

The strength reduction caused by the non-uniform lengths of the truss elements (as per Snelson) is described in detail as follows:

Three trusses of Figs. (a), (b) and (c) have similar tetrahedron structures. However, the three trusses of Figs. (a), (b) and (c) have the truss elements constituting the left slopes of the slightly different lengths, *i.e.*, 0.8a, a, and 1.2a, respectively, whereas the other truss elements have an identical length, a in the three trusses.

When the external force P is vertically applied to the vertexes, the force F1 acting in the left truss element of Fig. (a) is 2.15 times the forces F2 or F3 acting in the other two truss elements, and the forces acting in the three trusses disposed at the slope of Fig. (b) are equal to one another. On the other hand, the force F1 acting in the left truss element of Fig. (c) is merely 1/10 times the forces F2 and F3 applied to the other truss elements. That is, when the length of the truss element varies by ±20%, the force acting in the truss element can vary up to 0.1~2.15 times the force acting in the other two truss elements. Since the strength of the truss structure is governed by the truss element to in which the maximum force is acting, the ***non-uniform lengths*** of the truss element inevitably cause the weakening of the strength.

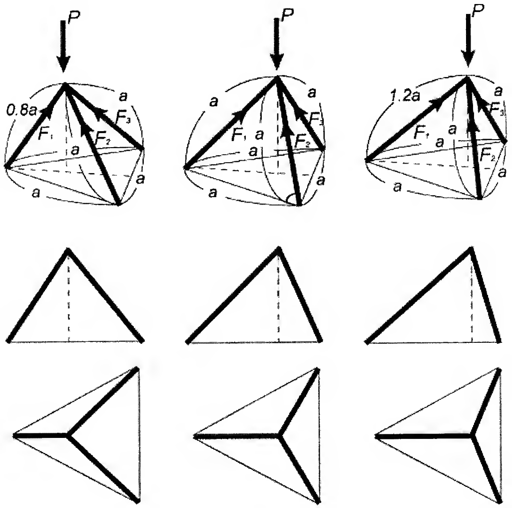


Fig. (a) Fig. (b) Fig. (c)

That is, (a) when the length of one side is 0.8a,

$$\boxed{\frac{20}{43}F_1 = F_2 = F_3, \quad \frac{5}{43}\sqrt{177}F_1 = P}$$

$$\boxed{F_1 = \frac{43}{20}F_2 = \frac{43}{20}F_3 = \frac{43}{5\sqrt{177}}P}$$

(b) When the lengths of three sides are all a,

$$\boxed{F_1 = F_2 = F_3 = \frac{P}{\sqrt{6}}}$$

(c) When the length of one side is 1.2a,

$$\boxed{10F_1 = F_2 = F_3, \quad 5\sqrt{13}F_1 = P}$$

$$\boxed{F_1 = \frac{1}{10}F_2 = \frac{1}{10}F_3 = \frac{1}{5\sqrt{13}}P}$$

Thus, whether the length of each side is constant and uniform causes a great difference in the mechanical strength of the whole structure and serves as the determinative factor in providing superior mechanical properties regardless of loading direction.

As mentioned above, the unit cell of the regular tetrahedron or hexahedron with equilateral sides is an essential element for the superior strength and rigidity of the three-dimensional cellular structure as is first taught with the present invention. The cited Snelson art does not disclose that the three-dimensional structure must have the regular tetrahedron or hexahedron structure with

equilateral sides, but merely suggests a method for implementing a polyhedron in a three-dimensional space. Thus, the structures of the two inventions seem to be similar in appearance, but the essence of the two disclosures are actually quite different.

Due in part to the reduced strength of the structures disclosed in Snelson, Snelson includes a joining member as a requisite bonding element in its disclosures. That is, if there is no joining member bonding the sides, it is difficult to maintain the structure in a three-dimensional polyhedron structure following the teachings of Snelson. As a result, it is necessary that Snelson structural rods must be fixed and bonded by joining members.

In stark contrast to Snelson, the present invention requires instead that the regular tetrahedron or hexahedron structure is repeatedly woven from continuous wires. Due to this novel structural aspect of the present invention, a three-dimensional cellular structure having a superior mechanical strength is implemented and a method for weaving continuous wires is provided. The cellular light structure of the present invention has superior strength and rigidity that is provided *even though there is no external fixing member or joining member at the intersection point of the wires bonding them together*.

Compared with the conventional cellular structure of the prior art, the three-dimensional cellular structure and the method of fabricating the same per the present invention remarkably improve the structural strength and rigidity, and the present invention provides a novel method allowing the fabrication of the cellular structure at low cost and in large quantities via a single process through the method of weaving continuous wires.

There is no disclosure in the cited Snelson reference suggesting that a three-dimensional cellular structure formed by repetition of the regular-tetrahedron unit cells might be or is stronger in strength or rigidity than other structures. Also, there is no suggestion or motivation provided by Snelson that repetitive mass-production is possible if the three-dimensional cellular structure is woven with continuous wires, further wherein the additional step of applying external bonding at the intersection points (to maintain structural strength and integity) between wires can be omitted. Such disclosure is only available to those of average skill in the art upon encountering the teachings of the

present disclosure. Consequently, Snelson does not provide enabling disclosure of the present invention, and thus Snelson cannot be deemed anticipatory art .

Finally, even the purpose behind the present invention and that of the cited prior art of Snelson are notably distinct. Snelson relates to a toy construction kit for three-dimensional geometrical structures, primarily useful for educational purposes or play. In contrast, the present invention relates to a method of mass-producing a three-dimensional wire-woven cellular light structure having superior strength and rigidity and thus industrially-applicable for engineering in a cost-effective manner and the resulting practical three-dimensional wire-woven cellular light structures fabricated thereby. It is clear that the presently claimed subject matter, when considering the structures, resulting improvements in structural strength and the central objectives of the current invention as compared to that of Snelson, is remarkably different and divergent from the prior art, including Snelson.

As the present invention and the prior art are thus quite different with regard to structure, construction, result and purpose, one of ordinary skill in the art would not have been enabled, based upon the Snelson disclosure alone, to understand and practice the present invention as claimed. Thus, the Snelson art cannot anticipate the present invention. Applicants thus respectfully request that the Examiner reconsider and withdraw the present rejection under 35 U.S.C. § 102(b) and deem claims 1-6 to be in suitable condition for allowance.

<u>Claim Rejections under 35 U.S.C. § 103(a) over Snelson in view of Ritter</u>

Claims 7-16 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Snelson (US/2002/0081936 A1) in view of Ritter et al. (US/2001/0010140 A1) for the reasons set forth in pp. 5-6 of the Office Action.

The Examiner alleges that those skilled in the art could easily carry out the inventions of claims 9 to 16 relating to the method of fabricating the three-dimensional wire-woven cellular light structure through a combination of the teachings of Snelson, relating to a method of implementing a polyhedron structure by using rod members in a three-dimensional space and a structure fabricated

thereby, with the teachings of Ritter, relating to a method of fabricating a mat for building and filling an empty space with a filler and its resulting material.

Applicants respectfully disagree with the Examiner's rejection. As mentioned above, the structures and methods of the present invention are clearly different from the structures and methods of the cited Snelson reference. Ritter separately provides a method of arranging flat wire meshes in parallel and connecting wires passing through both mats, and discloses a building material filled with a filler in an empty space. Note, however, that Ritter presents a process of arranging two wire grids in mats in a method that is time-consuming and cost-consuming and readily differentiated from the present methods. Furthermore, the unit structure of Ritter is distinct from that of a regular tetrahedron or hexahedron having optimal strength and rigidity. As a consequence, the structure woven by the Ritter method is lacking in strength and usefulness when compared to structures produced by the present method.

The Examiner alleges that those of ordinary skill in the art could easily derive the present invention from the combination of the Snelson and Ritter teachings. However, as mentioned above, there is no description in Snelson of a three-dimensional regular tetrahedron or hexahedron structure having equal sides for optimal strength and rigidity (nor is there such teaching in Ritter). As Snelson fails to provide the critical innovative structures of the present invention as a starting point, one of ordinary skill in the art would still lack the teaching, suggestion or motivation to come up with the precise structures described in claims 7-16, even in view of the Ritter reference and the then-contemporary state of the art.

Furthermore, while the present invention and the Ritter reference commonly feature a method of producing a wire-woven structure, they are nonetheless quite different with respect to the shapes of the structure and the weaving method for fabricating a specific shape. The Ritter method involves several steps rather than the single continuous process of the present invention, thus rendering the Ritter process an expensive and time-consuming process compared to that of the present invention, and a process furthermore resulting in a weaker final product. As such, there are distinct differences between Ritter and the present disclosure, and one of average skill in the art would lack the

motivation or suggestion to apply the methods of Ritter to the teachings of Snelson to result in the present invention as currently recited. Any belief that the teachings of Snelson and Ritter render the present invention obvious is likely due to hindsight bias rather than upon any actual or implied teachings presented by a combination of the two references, even when considered in view of the then-contemporary state of the art.

Applicants note again specifically that, even though the resulting structure of the present invention may be similar in certain aspects to one of the Snelson embodiments, the two inventions are nevertheless quite different with regard to the structure, resulting characteristics and underlying purpose of the respective disclosures, and the three-dimensional structures fashioned by the present invention as claimed are far superior in strength and rigidity (because of the shape of the unit cell) when compared with the structures fabricated by the methods of the Ritter reference. Since the number of processes is remarkably reduced in the present disclosure relative to those of Ritter, the structure of the present invention can be fabricated at low cost and in a short time by a single process through use of continuous elongated wires. Consequently, it is readily apparent that the structure and methods of the present invention are distinct and superior in a novel and non-obvious fashion relative to those as presented by either Snelson, Ritter or the Snelson and Ritter references in combination.

Applicants reiterate that for the reasons provided above, Snelson does not anticipate the present disclosure. Furthermore, as Snelson emphasizes the importance of bonding by joining members at intersections to enhance strength, a practitioner of average skill in the art would not have the suggestion or motivation to pursue the present invention, particularly *without the use of bonding between members*, nor would such a practitioner consider such a method or any of the present methods obvious or reasonably expect success in pursuing such methods, even when viewed in combination with the teachings of Ritter. Rather, it is only with the present disclosure that one of average skill in the art would recognize and understand the value of using the present methods and of producing the presently-disclosed structures and readily be able to put the invention into practice.

The Examiner is thus respectfully requested to reconsider and withdraw the rejection of claims 7-16 under 35 U.S.C. § 103 over Snelson in view of Ritter.

Summary

Entry of this Amendment, including replacement formal drawings for Figures 9, 13 and 14, into the file of the application is respectfully requested. The remarks presented above are believed to be sufficient to overcome all of the objections and rejections to the claims of the present application. The Examiner is, therefore, respectfully requested to reconsider and withdraw the subject rejections and to pass the application through to an allowance.

If the Examiner does not agree, however, but believes that an interview would advance the progress of this case, the Examiner is respectfully invited to telephone applicants' representative at the number below so that an interview may be scheduled.

THIS CORRESPONDENCE IS BEING SUBMITTED ELECTRONICALLY THROUGH THE PATENT AND TRADEMARK OFFICE EFS FILING SYSTEM ON May 5, 2009.

Respectfully submitted,

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RCF/AGG:stb:rra

Attachments